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EXAMINER

MAI, ANH D

ART UNIT PAPER NUMBER

2814

DATE MAILED: 04/24/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

H.F

Office Action Summary

Application No.

10/669,568

Applicant(s)

KOIDE, TATSUHIKO

Examiner

Anh D. Mai

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
 Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 March 2006.
 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 5, 6 and 11-28 is/are pending in the application.
 4a) Of the above claim(s) 16-26 is/are withdrawn from consideration.
 5) ☐ Claim(s) _____ is/are allowed.
 6) ☒ Claim(s) 5, 6, 11-15, 27 and 28 is/are rejected.
 7) ☐ Claim(s) _____ is/are objected to.
 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
 Paper No(s)/Mail Date _____.
 4) ☐ Interview Summary (PTO-413)
 Paper No(s)/Mail Date _____.
 5) ☐ Notice of Informal Patent Application (PTO-152)
 6) ☐ Other: _____.

DETAILED ACTION

Status of the Claims

1. Amendment filed March 16, 2006 has been entered. Claims 1-4 and 7-10 have been cancelled. Claims 5, 6 and 11-13 have been amended. Claims 27 and 28 have been added. Non-elected invention, claims 16-26 have been withdrawn. Claims 5, 6 and 11-28 are pending.

Claim Objections

2. Claim 15 objected to because of the following informalities:

Since the limitation of claim 15 is an additional to the limitations of claim 13, therefore, claim 15 should recite: "the semiconductor device as set forth in claim 13, **further comprising** a metal interconnect...".

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

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3. Claims 5, 13 and 14 are rejected under 35 U.S.C. 102(b) as being anticipated by Gnade et al. (U.S. Patent No. 5,494,858) of record.

With respect to claim 5, Gnade teaches a semiconductor device as claimed including:

a semiconductor substrate (22); and

a dielectric film including a porous film (28) and a non-porous film (30) in contact therewith formed on the semiconductor substrate (22)

wherein the porous film (28) and the non-porous film (30) are substantially of identical composition (silicon dioxide), (see Fig. 1D),

pores are distributed in a relatively lower density in the proximity of the upper surface of the dielectric film, and

the dielectric film includes an area where density of the pores varies gradually toward the upper surface of the dielectric film. (See Fig. 3B).

With respect to claim 13, Gnade teaches a semiconductor device as claimed including:

a semiconductor substrate (22); and

a dielectric film having a substantially uniform composition including a porous portion;

wherein pores in the porous portion are distributed in a relatively lower density either in the proximity of an upper surface or in the proximity of a lower surface of the dielectric film, and

the dielectric film includes an area where density of the pores varies gradually toward the upper surface or the lower surface of the dielectric film. (See Fig. 3B).

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With respect to claim 14, the pores of Gnade are distributed in a relatively lower density in the proximity of an upper surface of said dielectric film.

4. Claims 6, 12, 27 and 28 are rejected under 35 U.S.C. 102(e) as being anticipated by Xia et al. (U.S. Patent No. 6,699,784) of record.

With respect to claim 6, Xia teaches a semiconductor device as claimed including:

a semiconductor substrate; and

a dielectric film including a porous film (102) and a non-porous film (104) in contact therewith formed on the semiconductor substrate;

wherein the porous film (102) and the non-porous film (104) are substantially of an identical composition, and

a metal interconnect (106) is provided in the dielectric film, such that an upper surface of the metal interconnect (106) and that of the dielectric film are aligned in the same plane. (See Fig. 6, col. 3, line 46 to col. 4, line 22).

With respect to claim 12, Xia teaches a semiconductor device as claimed including:

a semiconductor substrate; and

a dielectric film including a porous film (102) and a non-porous film (104) in contact therewith formed on the semiconductor substrate;

wherein the porous film (102) and the non-porous film (104) both contain Si, O and C, and

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a metal interconnect (106) is provided in the dielectric film, such that an upper surface of the metal interconnect (106) and that of the dielectric film are aligned in the same plane. (See Fig. 6, col. 3, line 46 to col. 4, line 22).

With respect to claims 27 and 28, the metal interconnect (106) of Xia is a damascene interconnect line.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim 6 is further rejected under 35 U.S.C. 103(a) as being unpatentable over Forbes et al. (U.S. Patent No. 6,548,107) in view of Xia '784.

Forbes teaches a semiconductor device substantially as claimed including:

a semiconductor substrate (12); and

a dielectric film including a porous film (30) and a non-porous film (32) in contact therewith formed on the semiconductor substrate (12);

wherein the porous film (30) and the non-porous film (32) are substantially of an identical composition, and

a metal interconnect (16) is provided in the dielectric film. (See Fig. 5).

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Thus, Forbes is shown to teach all the features of the claim with the exception of explicitly forming the metal interconnect such that the upper surface of the metal interconnect and that of the dielectric film aligned in the same plane.

However, Xia teaches a semiconductor device including a metal interconnect (106) is provided in the dielectric film including a porous film (30) and a non-porous film (32) such that the upper surface (110) of the metal interconnect and that of the dielectric film are aligned in the same plane. (See Fig. 1E).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention was made to have the metal interconnect's upper surface of Forbes aligned in the same plane with the upper surface of the dielectric film as taught by Xia for the well known intended purpose of exposing the surface of the metal interconnect to allow access to other areas of the device and furthermore to improve the planarity of the structure thereby allowing for a multi-level structure that improves integration of the device.

6. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gnade '858 in view of Xia '784.

Gnade teaches a semiconductor device substantially as claimed including:

a semiconductor substrate (22); and

a dielectric film including a porous film (28) and a non-porous film (30) in contact therewith formed on the semiconductor substrate (22),

wherein the porous film (28) and the non-porous film (30) both contain the same material (see Fig. 1D),

pores are distributed in a relatively lower density in the proximity of the upper surface of the dielectric film, and

the dielectric film includes an area where density of the pores varies gradually toward the upper surface of the dielectric film. (See Fig. 3B).

Thus, Gnade is shown to teach all the features of the claim with the exception of explicitly utilizing dielectric material contain Si, O and C.

Note that, precursor TEOS and TMCS are organo silane, thus, trace of carbon, might have been within the dielectric film. Although Gnade does not specifically acknowledge.

However, Xia teaches a semiconductor device having a dielectric film including a porous film (102) and non-porous film (104) and both films contain Si, O and C. (See Fig. 1A).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention was made to form the dielectric film of Gnade utilizing dielectric material contains Si, O and C as taught by Xia to further reduce capacity coupling between adjacent metal lines.

7. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gnade '858 as applied to claim 13 above and further in view of Xia '784.

Gnade further teaches a metal interconnect (24) is provided in the dielectric film. (See Fig. 1D),

Thus, Gnade is shown to teach all the features of the claim with the exception of explicitly forming the metal interconnect such that the upper surface of the metal interconnect and that of the dielectric film aligned in the same plane.

However, Xia teaches a semiconductor device including a metal interconnect (106) is provided in the dielectric film including a porous film (30) and a non-porous film (32) such that the upper surface (110) of the metal interconnect and that of the dielectric film are aligned in the same plane. (See Fig. 1E).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention was made to have the metal interconnect's upper surface of Forbes aligned in the same plane with the upper surface of the dielectric film as taught by Xia for the well known intended purpose of exposing the surface of the metal interconnect to allow access to other areas of the device and furthermore to improve the planarity of the structure thereby allowing for a multi-level structure that improves integration of the device.

Response to Arguments

8. Applicant's arguments with respect to claims 5, 11-15, 27 and 28 have been considered but are moot in view of the new ground(s) of rejection.

9. Applicant's arguments, with respect to claim 6, filed March 16, 2006 have been fully considered but they are not persuasive.

In response to applicant's arguments against the references individually, such as the metal interconnect of Forbes does not aligned to the same plane of the dielectric film, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Note that, the planarity of the metal interconnect and the dielectric film should be easily determined by one having ordinary skill in the art such that the planar surface of the metal interconnect and the dielectric film to allow access to other areas of the device and furthermore to improve the planarity of the structure thereby allowing for a multi-level structure that improves integration of the device.

Applicants further add: "Fig. 1E of Xia et al. shows that an upper surface of interconnect 106 and that of hardmask 104 formed on dielectric layer 102 are aligned in the same plane. It is therefore apparent that an upper surface of interconnect 106 and that of dielectric layer 102 are not aligned in the same plane in Xia et al."

The Applicants' conclusion is just that. One should evaluate a layer in its position. For instant, layer 104 of Xia is exactly the same as that of layer 17 of the instant application, Fig. 2A. Both layers are there for the same purpose, acting as an etch stop. In Fig. 1E, clearly, the upper surface of the metal interconnect 106, is aligned with that of layer 104, which is a portion of the dielectric film.

Thus, the combination of the references clearly renders claim 6 obvious.

Conclusion

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (571) 272-1710. The examiner can normally be reached on 8:00AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


ANH D. MAI
PRIMARY EXAMINER